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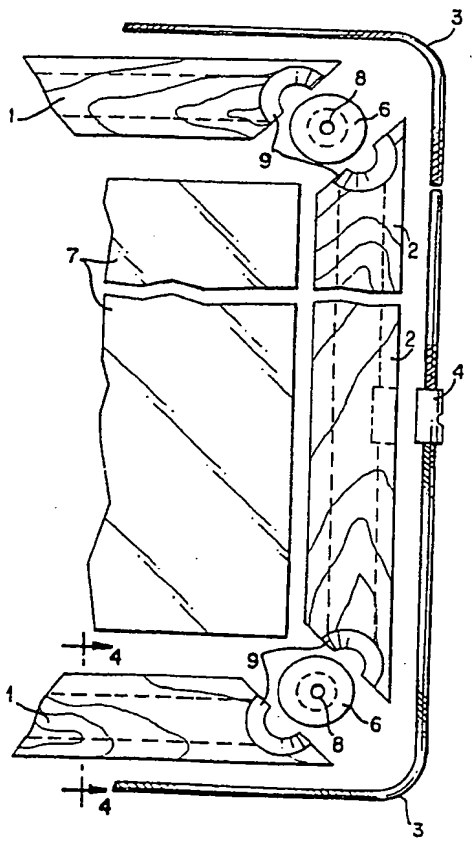
(54) Title: COMPRESSION FRAMING SYSTEM

(57) Abstract

A modular system of structural framing in which a multiplicity of pre-stressed compression frame modules are combined into frameworks of any required size by use of common connecting means such as plates and brackets. Each compression frame module comprises a plurality of framing members (1, 2) forming a polygonal frame. The ends of each framing member are shaped to provide a non-invasive means of engaging and joining abutting framing members (1, 2). A tensioned loop means (3) longitudinally encircles the frame. The tensioned loop serves as the single fastener holding the module together while simultaneously pre-stressing the module by putting it into compression, thereby achieving a synergistic strength. Additionally, non-invasive joint pieces (6) separate and distinct from the framing members (1, 2) and a removable double-cam clamping device (4) are provided to improve the functionality of the system and to facilitate use of interchangeable parts.



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Title: COMPRESSION FRAMING SYSTEM

FIELD OF INVENTION

This invention relates generally to building components, and more particularly to a pre-stressed modular framing system comprised of interchangeable parts.

Invention of the compression framing system was prompted by a need for a modular system of wood framing for outdoor privacy screening. This privacy screening is to be glazed with translucent fiberglass-reinforced plastic panels that transmit sunlight while providing visual privacy by blurring images. For this application, known framing methods produced frameworks that devoted insufficient surface area to the light-transmitting material, that did not allow modular construction using interchangeable parts, and that were not strong enough to withstand forces of wind and weather.

BACKGROUND--PRIOR ART

In the several arts related to methods of manufacturing and construction of frames and frameworks:

In the manufacturing arts it is known to:

- employ longitudinally extending members such as metal straps laterally around a formation of staves or the like to hold together the pieces of a container such as a barrel.

In the picture framing arts it is known to:

- employ a cord or other longitudinally extending member as the means of holding an ornamental picture frame together;
- use clamping devices employing a cable and fittings to hold framing members for fastening with nails or glue.

In the building arts it is known to:

- use clamping devices with a cable or chain and fittings to hold concrete forms together as the concrete solidifies;
- form framing members into static frameworks by using piercing metal fasteners to attach framing members to one another;
- form framing members into static frameworks by using adhesives or welds to fasten framing members together;
- use cables to suspend structures such as bridges;
- incorporate a tensioned cable as a tendon in a cementitious structural formation as a means of pre-stressing it against the forces of its load.

The methods common to static framing, especially the use of adhesives or conventional fasteners to fix framing members together in a rigid construct, do not produce light-weight frameworks able to withstand forces of wind and weather, and do not facilitate the use of interchangeable parts. In lightweight framing applications such as that contemplated by the preferred embodiment of the present invention, both conventional fasteners and glue joinery produce static frame joints that are not strong enough to withstand water degradation and the force of wind flexion. Moreover, glue technology is time- and labor-intensive, and piercing fasteners such as nails, screws, bolts, or dowels damage the integrity of framing members. Such damage by invasive fasteners is particularly evident in wood framing

that has come under stress.

The synergy achieved in pre-stressing of concrete by cable-induced compression and the resulting enhancement of the material's natural characteristics are well known. To determine a means of adapting cable-compressed pre-stressing to a system of modular framing, reference was made to the methods of skeletal framing. In skeletal frames, bones are held in a framework by tendons and tensioned muscles, with non-invasive joints where bones intersect.

The present invention has drawn upon anatomical construction in the design of a non-invasive means of joining framing members. The means of joining abutting framing members in the compression framing system has been derived from an examination of bone joints. Use of non-invasive joints improve the manner of engagement of the component parts of a compression frame: framing pieces and the tensioned loop holding each frame module together in a compressed state. For manufacturing considerations and to permit use of engineering plastics in a wood framing system, the preferred embodiment discloses a corner joining piece that is separate from the framing members, and a shaping of the framing members to accommodate such separate corner pieces.

None of the prior art known to applicant reveals pre-stressing of frames, use of interchangeable parts in construction of modular frames, or use of non-invasive joinery. Also novel according to the prior art known to applicant is the two-piece double-cam clamping device provided to allow tensioned cable loops to be quickly formed and to further facilitate use of interchangeable parts.

OBJECTS OF THE INVENTION

The first chief object of this invention is to provide a system of modular framing in which the modules can be made of interchangeable parts, easily assembled into extensive modular structures of any required size, and thereafter

easily disassembled as required for repair, maintenance, or replacement.

The second chief object of this invention is to provide a modular framing system of superior strength, such that a light-weight but strong framework can be constructed.

Another object of this invention is to provide a modular framing system with structural flexibility, such that typical stress conditions may induce temporary flexion but no permanent damage.

Another object of this invention is to provide a framing module the manufacturing of which avoids adhesives and conventional invasive fasteners such as nails or screws that pierce the framing members being secured.

Another object of this invention is to provide a system of modular framing the component parts of which can be engineered to satisfy the requirements of varied specific applications other than privacy screening, for example: load-bearing walls; curtain walls and other non-load-bearing partitions; frames within frames such as those required for windows and doors; and domes.

The embodiment disclosed in the drawings is built from coplanar rectangular compression frames extending to make a framework in a single plane--which in turn may be connected to another such framework in a second plane or may be connected to an existing structure. To make a framework extending out into several planes, as in the case of a dome, each compression frame module might typically have three or five coplanar framing members, the framing members being of non-rectangular cross-section to facilitate abutment of frames in a three-dimensional configuration in several planes.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1. is a perspective view showing a right-angle intersection of a multiplicity of compression framing modules in a two-frame- high configuration.

FIG. 2a. is an elevation view of the left half of a compression frame module using a pulley-type corner piece.

FIG. 2b. is an exploded view of the right half of the frame as shown in FIG. 2a, showing the component parts.

FIG. 3. is a section view of a compression frame through a pulley corner piece, viewed as indicated in FIG. 2a.

FIG. 4. is a section view of a framing member of a compression frame, viewed as indicated in FIG. 2b.

FIG. 5. is an enlarged, detailed view of the cable loop clamping device, in the same view shown in FIG. 2b.

FIG. 6. is an enlarged elevation of the cable loop clamping device, as it would appear from the right side of FIG. 2b.

FIG. 7. is a longitudinal section view of the cable clamping device, as indicated in FIG. 5, showing the functional relationship of the parts, and especially disclosing two radially opposed toothed cams formed within grooves provided in the clamping sphere.

FIG. 8. is a transverse section view of the cable clamping device as indicated in FIG. 5, rotated counter-clockwise 90 degrees.

FIG. 9. is an elevation view of an alternative, pincer-type, non-invasive corner piece.

FIG. 10. is a section view--as indicated in FIG. 9--of the pincer-type corner piece.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A system of modular framing in accordance with the invention as shown in FIG. 1 is comprised of a multiplicity of discrete pre-stressed compression frame modules combined together into a modular framework by the employment, as required, of two hole plate 12 or four hole plate 13, and two hole bracket 14 or four hole bracket 15, with bolts 16.

As depicted in FIG. 2a and FIG 2b, each frame of this framing system is a compression frame module comprised of: three framing members 1 and one framing member 2; four

pulley-type corner pieces 6; light 7; cable loop 3; and two-part cable loop clamp 4,5. Framing member part 2 differs from part 1 only in that it is grooved as depicted in FIG. 2b to receive cable clamp housing 4. Corner piece 6 (and 17 in FIG. 9 and FIG. 10) is provided with threaded hole 8 for bolts 16 to secure connecting plates 12, 13, and brackets 14, 15. The center of threaded hole 8 is located at the intersection of the center lines of the faces of framing member 1,2.

FIG. 3 depicts a section through the intersection of two framing members 1 engaging a pulley-type corner piece 6; this figure would be no different if one framing member was part 2 instead of part 1.

FIG. 4 depicts a section through a framing member 1, showing groove 10 for cable loop 3 and groove 11 for light 7; this figure would be different for framing member 2 only if the section was taken through the groove cut for cable clamp housing 4.

Assembly of a rectangular compression frame module proceeds as follows: three framing members 1 and one framing member 2 are introduced around the perimeter of light 7 by inserting each edge of light 7 into groove 11 of each framing member. At each intersection of framing members 1 and 1 or 1 and 2 a pulley-type corner piece 6 is placed, engaged by the shaping 9 on each end of each framing member 1,2.

Once the parts are arranged as described, cable loop 3 is caused to longitudinally encircle the module by its insertion in groove 10. Cable loop 3 engages each pulley corner piece 6 at the flat of its groove 6a, outbound of threaded hole 8.

When the frame module is fully encircled, cable ends 3a and 3z are passed through opposite ends of tubular clamp housing 4 as shown in FIG. 6, with end 3a to the top left and 3z to the bottom right as viewed from the right edge of the frame as shown in FIG. 2b. Clamp housing 4 is aligned over its groove in framing member 2, with key access hole 5c

facing outward. Cam-action clamping sphere 5 is inserted into clamp housing 4 with grooves 5a engaging cable loop 3, this being done such that each of the two radially opposed toothed cams 5b incorporated in each of two grooves 5a of clamping sphere 5 is positioned respectively toward cable loop ends 3a and 3z, and with key socket 5c being centered beneath key access hole 4a. The two clamping sphere grooves 5a have each been formed with a depth that varies as shown in FIG. 7 such that two radially opposed cams 5b are formed, with key socket 5c serving as the center of the axis of rotation in relation to which cams 5b are radially opposed.

When all the component parts of the module are thus in place, cable loop ends 3a and 3z are gripped by a mechanical or hydraulic device with which to introduce tension on cable loop 3. Cable loop 3 is tensioned, and a key is inserted in key socket 5c and turned so that the two toothed cams 5b of clamping sphere 5 respectively and simultaneously engage cable ends 3a, 3z; in FIG. 6 or 7, the key would be turned in a counter-clockwise direction. Clamping sphere 5 is held thus in its rotated position as cable ends 3a and 3z are released from the tension-inducing device.

Upon release by the tensioning means cable loop ends 3a and 3z recoil and simultaneously engage radially opposed toothed cams 5b located in grooves 5a in each side of clamping sphere 5 and, so engaged, cause sphere 5 to rotate farther in the direction of key-induced rotation to the point at which its double camming action, within the confinement of clamp housing 4, causes both ends of cable loop 3 to simultaneously be jammed tight against opposite inside walls of clamp housing 4. This procedure expends only a small portion of the tension initially applied to the cable loop. The remaining tension is retained in the cable loop by the double cam action of clamp 4,5. Thus tensioned, cable loop 3 longitudinally compresses the frame, thereby pre-stressing it.

Disassembly of a framework is simply a reversal of the assembly process described above, requiring the unbolting of

plates and brackets and the removal of frame modules.

Disassembly of a framing module requires that cable loop 3 again be mechanically or hydraulically tensioned to allow the cable clamping sphere 5 to be rotated so as to disengage toothed cams 5b from cable loop 3. Tension is then released from cable loop 3, cable loop ends 3a, 3z are pulled out of clamp housing 4, and any of the other parts can easily be removed from the module.

In the alternative, as shown in FIG. 9 and FIG. 10, a pincer-type corner piece 17 can be employed instead of a pulley-type 6. Like pulley-type corner piece 6, said pincer-type corner piece 17 has a threaded hole 8 at the intersection of the center lines of the faces of the two abutting frame members 1,2, and engages cable loop 3 in its groove 17a. Alternative shaping of framing members 1,2 to engage corner piece 17 is shown at 9a in FIG. 9 and FIG. 10.

SUMMARY AND SCOPE

Accordingly, the reader will see that the compression framing system of this invention can be used:

- to build frame modules and frameworks entirely from interchangeable parts;
- to achieve synergy with the material components, allowing compression frames to be built stronger, using less material, than conventional static frames;
- to quickly fabricate and assemble pre-stressed compression frame modules;
- to quickly install frameworks of any size by connecting the required number of compression frame modules together;
- to build frameworks that last longer by avoiding invasive fasteners that hasten degradation of framing members.

Although the description above contains many specificities, these should not be construed as limiting the

scope of the invention but as merely providing illustrations of some of the presently preferred embodiments of this invention. Compression frame modules can be engineered to serve a wide variety of structural purposes. This invention provides a means for fabricating entire buildings wholly from interchangeable parts, and also provides a means for making many component parts, such as doors and windows.

Thus, the scope of the invention should be determined by the appended claims and their legal equivalents, rather than by the examples given.

CLAIMS

I claim:

1. A structural framing unit comprising:
(a) a plurality of longitudinally extending coplanar framing members sequentially abutting one another to form altogether a polygonal frame;
(b) a tensioned loop means, to which tension has been applied concurrent with formation of the loop, said tensioned loop means longitudinally extending to encircle said polygonal frame such that said tensioned loop means functions as a single fastener by which said polygonal frame is held together as a module, while simultaneously communicating its tension to said module encircled thereby, thus functioning as means of pre-stressing said module, resulting in compression of the framing module; whereby a compression frame module can be made entirely of interchangeable parts, assembled or disassembled more quickly than a static frame made by conventional means, and made synergistically stronger than a conventional static frame of the same weight.

2. A compression frame module according to claim 1 further including the ends of each said framing member being shaped so as to allow abutting framing members to engage and join in a manner that provides means of:
(1) assisting in communication of said tension of said loop means to said frame module;
(2) combining with said tensioned loop means to secure each said framing member in correct position relative to other framing members in the module;
(3) maintaining under stress the integrity of the framing members by holding them in said correct position while avoiding invasion of said integrity in any manner similar to that effected by piercing of nails or screws;
(4) furnishing attachment means, such as a threaded hole, for means of connecting a multiplicity of said

frame modules together;

whereby assembly and pre-stressing of frame modules is facilitated, longevity of framing members is increased by eliminating damage caused by invasive fasteners, and the connecting together of frame modules is made easier.

3. A compression frame module according to claim 1 further including a separate corner piece at each abutment of framing members, positioned such as to act in combination with said loop means and said frame module, to facilitate providing means of:

(1) assisting in communication of said tension of said loop means to said frame module;

(2) combining with said tensioned loop means to secure each said framing member in correct position relative to the other framing members in said module;

(3) maintaining under stress the integrity of the framing members by holding them in said correct position while avoiding invasion of said integrity in any manner similar to that effected by piercing of nails or screws;

(4) furnishing attachment means, such as a threaded hole, for means of connecting a multiplicity of said frame modules together;

whereby the assembly and pre-stressing of compression frame modules is facilitated, longevity of framing members is increased by eliminating damage caused by invasive fasteners, compression frame modules can be easily connected together, and corner joining pieces and framing members can be made from different material and by separate manufacturing operations as desired.

4. A compression frame module according to claim 3 wherein said corner piece is a pulley configuration.

5. A compression frame module according to claim 3 wherein said corner piece is a pincer configuration.

6. A compression frame module according to claim 1 wherein said loop means which longitudinally encircles said polygonal frame is made from cable material.

7. A compression frame module according to claim 1 further including a removable clamping device for securing said loop means in a tensioned state, said clamping device comprising the following two component parts:

(a) a clamping piece comprising two opposing toothed cams that are radially symmetrical in respect to the axis of rotation of said clamping piece;

(b) a housing to contain said clamping piece configured such that opposite ends of the loop means can pass through and be clamped against opposing inside walls of said housing by the two cams of the clamping piece, and also configured such that a means of rotating the clamping piece can be employed.

8. A compression frame module according to claim 7 further including in the clamping device a socket positioned at the center of the axis of rótation of the double-cam piece whereby a common tool can be used as a key to rotate the clamping piece during assembly and disassembly of compression frame modules.

9. A compression frame module according to claim 8 wherein the component parts of said clamping device are as follows:

(a) a housing piece of tubular configuration, with a hole in the wall of the tubular housing to allow entry of said common tool to be used as a key to rotate the double-cam clamping piece during assembly and disassembly of said compression frame modules;

(b) a clamping piece of generally spherical configuration in which the two cams of said clamping piece are comprised within the spherical configuration, the spherical diameter being slightly smaller than the diameter of the inside of said tubular housing;
whereby the two component parts of the clamping device can be easily mated with each other and with the loop means, speeding assembly of the module.

10. A compression frame module according to claim 1 wherein slots in each framing member are provided for the tensioned loop means to reside in as it longitudinally encircles the polygonal frame.

11. A compression frame module according to claim 1 further including a panel of glazing or other material inserted into longitudinal slots provided in each framing member to allow said panel to be securely held within the module.

12. A system of framing in which a multiplicity of compression
frame modules are configured into frameworks by use of commonly known connecting means including plates and brackets, whereby said frameworks extending to any aggregate size can be built entirely of easily interchangeable parts engineered to the specific demands of many varied specific structural applications, including curtain walls, load-bearing walls, frames-within-frames such as doors and windows, dome structures, and other building structures.

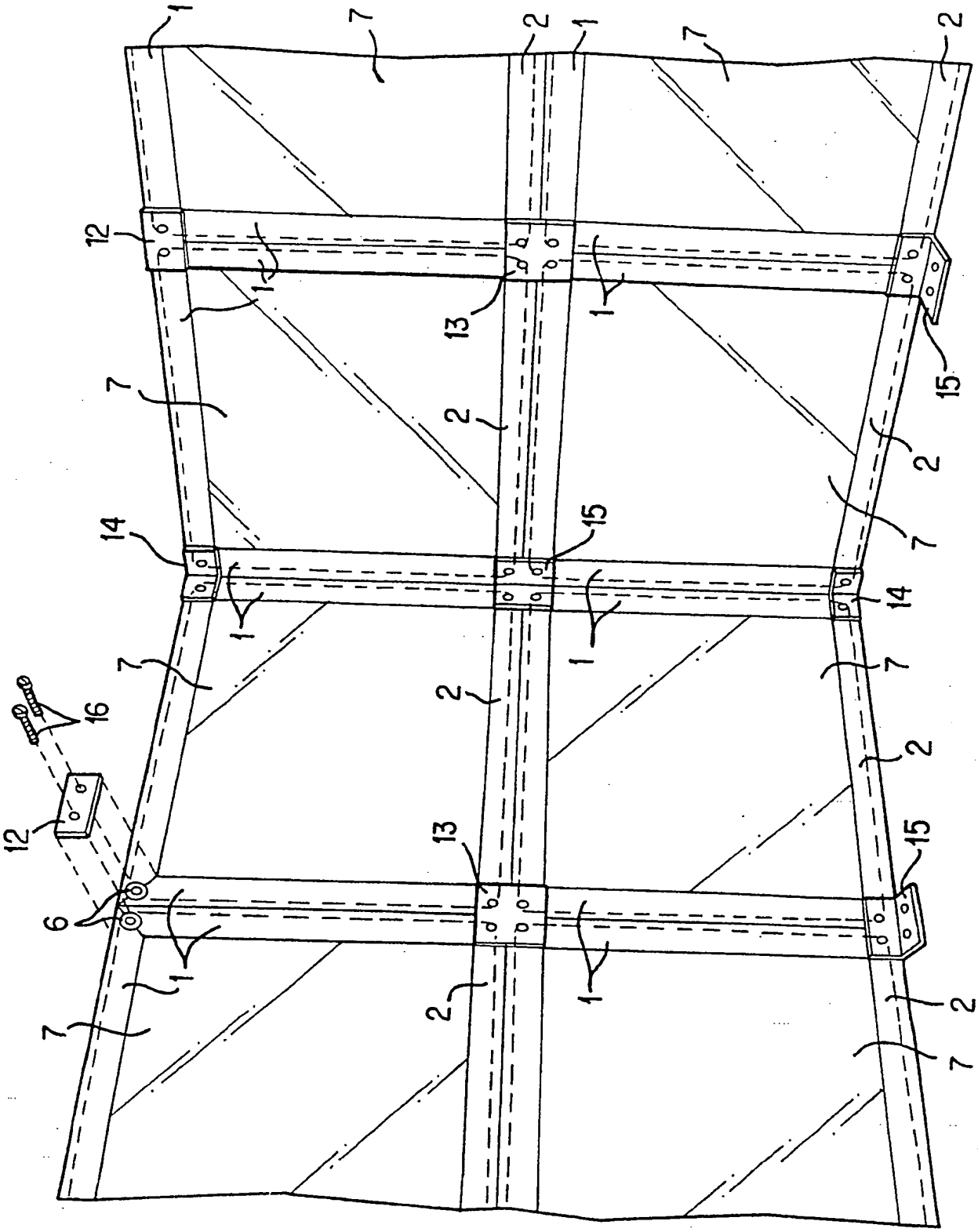

FIG.1

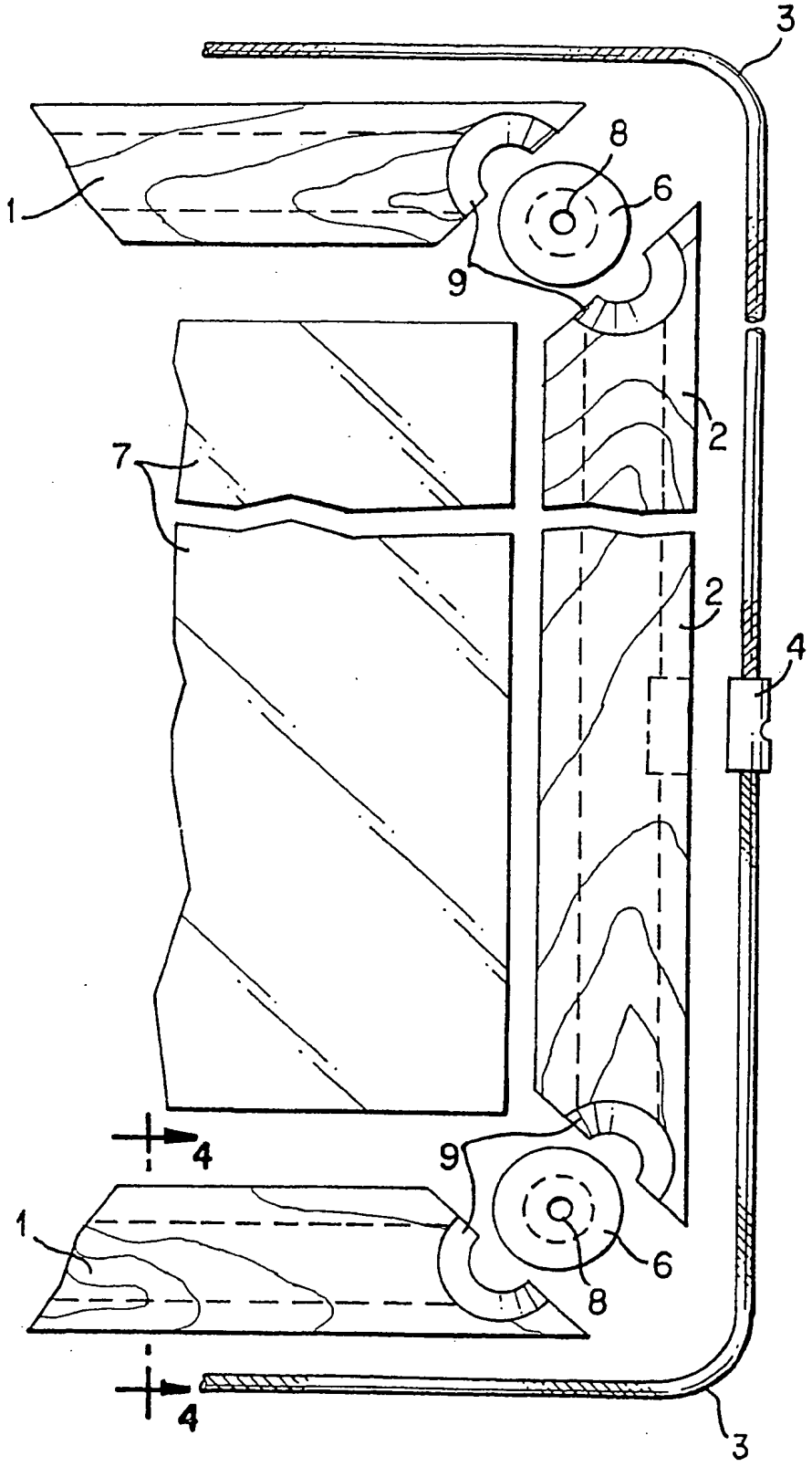

FIG. 2b

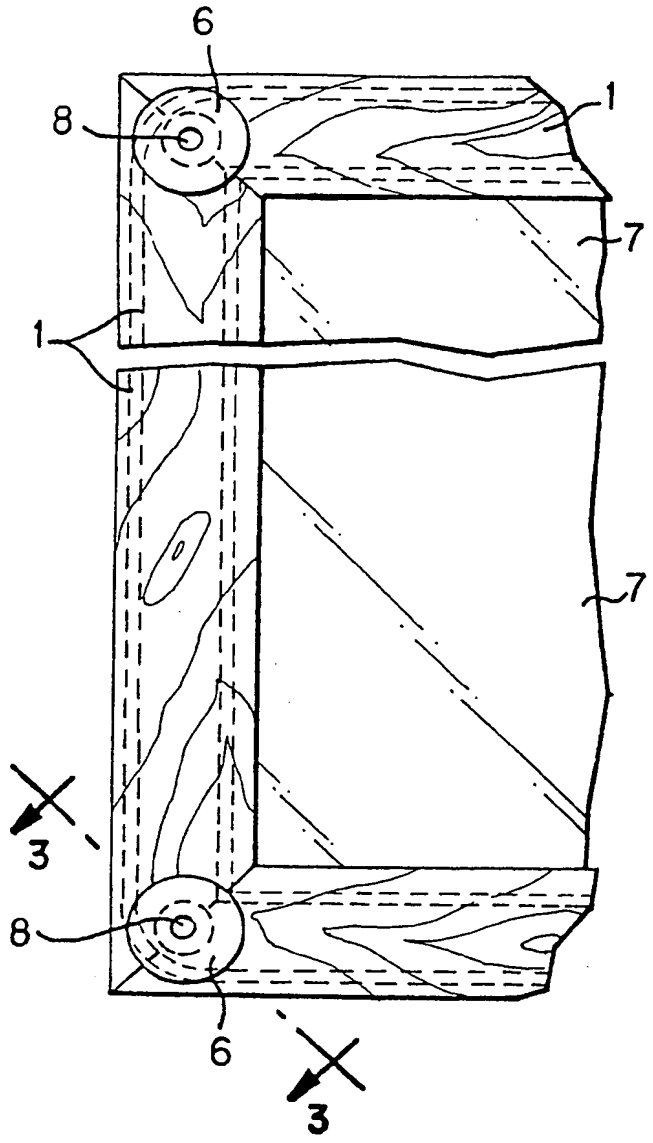

FIG. 2a

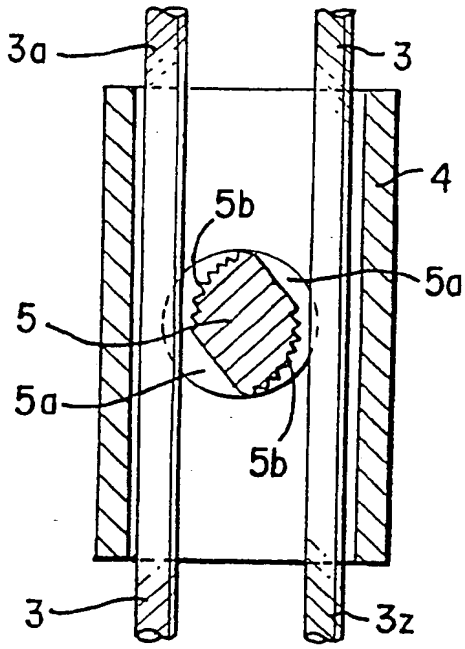

FIG. 7

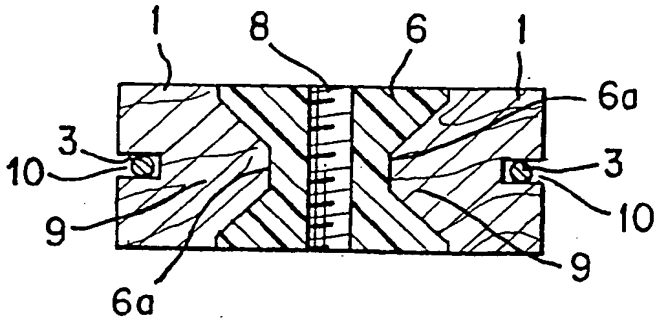

FIG. 3

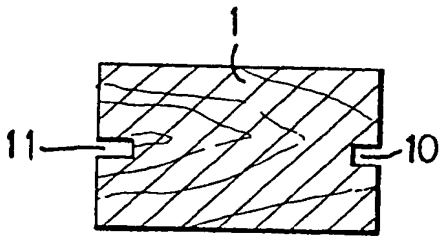

FIG. 4

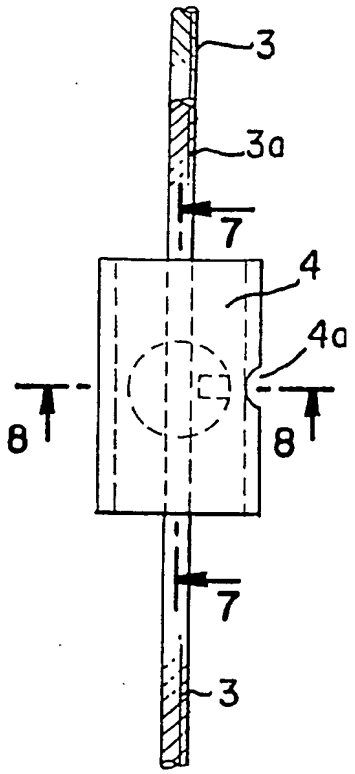

FIG. 5

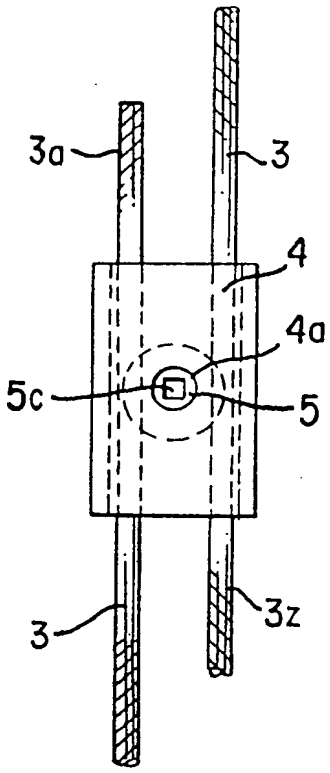

FIG. 6

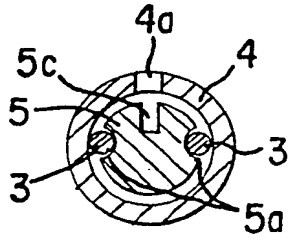

FIG. 8

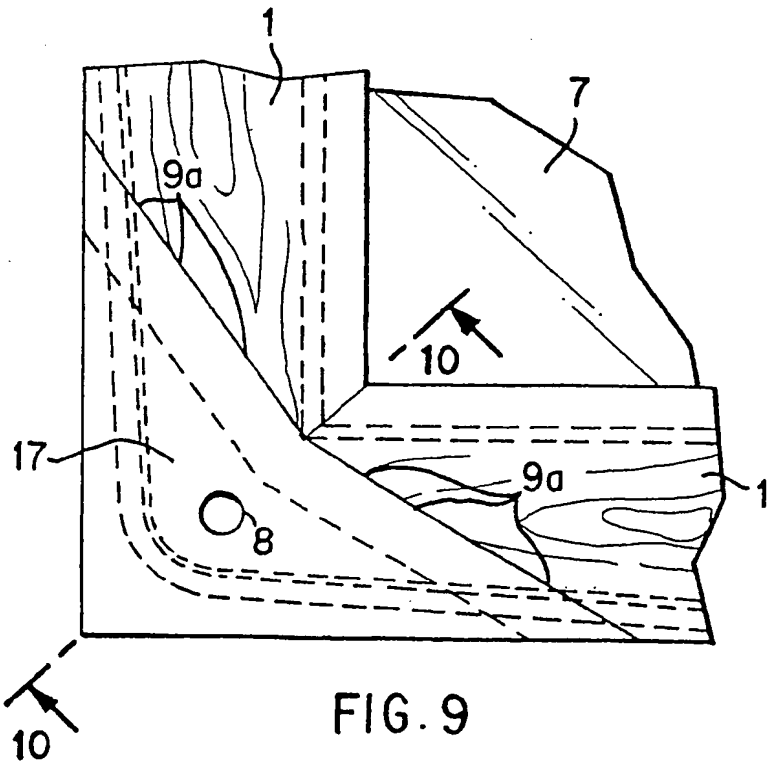

FIG. 9

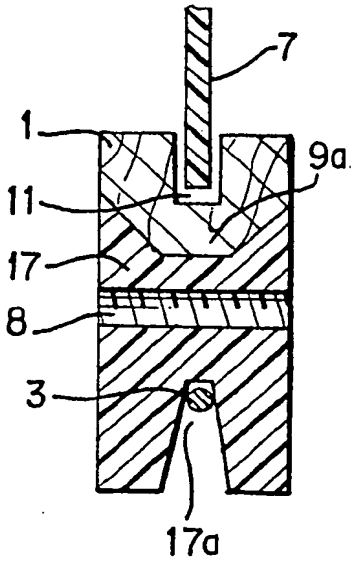

FIG. 10

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 91/07376

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 E06B3/96; A47G1/06; E04C2/38

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	E06B ; A47G ; E04F ; E04C

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X A	DE,B,1 250 622 (ALUMINIUM EXTRUSION COMPANY) 21 September 1967 see the whole document	1,6,10, 11 2,3,5
X A	FR,A,2 529 626 (BIANCO) 6 January 1984 see page 3, line 35 - page 4, line 33; figures 1-4	1,6 2,3,5
A	BE,A,715 512 (L. BREWERS) 16 October 1968 see page 6, paragraph 5 - page 10, paragraph 2; figures	1,3,5,7, 8
A	FR,A,2 095 529 (VEREINIGTE ALUMINIUM-WERKE) 11 February 1972 see the whole document	1-4

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
05 JUNE 1992	29. 06. 92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	DEPOORTER F.

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	EP,A,0 193 467 (STIVA-STEPH SIMON EDITIONS) 3 September 1986 see page 3, line 1 - page 4, line 33; figures	1-6
A	US,A,4 017 989 (MURRAY) 19 April 1977 see claim 1; figures	8

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. US 9107376 SA 56482

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 05/06/92
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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FR-A-2529626	06-01-84	None	
BE-A-715512	16-10-68	NL-A- 6806512	25-07-68
FR-A-2095529	11-02-72	BE-A- 766165	16-09-71
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		LU-A- 63031	26-08-71
		NL-A- 7106922	06-12-71
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